The Impact of Bottom Roughness and Bioturbation Intensity on Benthic Optical Properties

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LONG-TERM GOALS

The ultimate objective of this research program is to identify and obtain a predictive understanding of the physical and biological processes responsible for the formation and maintenance of the microtopography (decimeter to millimeter) of the sea floor. To achieve this goal, it is necessary to study formative processes occurring on the sediment surface (e.g., biogenic mound formation, ripple development), as well as processes occurring within the seabed (e.g., bioturbation, compaction) which generally lessen microtopography. The approach to this area of interest is predominantly field-oriented, with a secondary emphasis on model development.

OBJECTIVES

The primary goal of this project, which is part of the Coastal Benthic Optical Properties (CoBOP) DRI, is the quantification of bottom roughness along transects extending from open sand flats to seagrass meadows at two shallow water sites: Monterey Harbor, California and Lee Stocking Island, Bahamas. Specific questions include: (1) What is the sediment bottom roughness at each site?, (2) Does sediment bottom roughness vary spatially in a predictable manner (e.g., away from the seagrass meadow)?, (3) Does sediment bottom roughness vary significantly in time?, and (4) What is the relationship between sediment bottom roughness and bioturbation intensity? The bottom roughness and bioturbation measurements will be made in the context of research conducted by other CoBOP investigators.

APPROACH

Measurements of bottom roughness will be made using a 35-mm PhotoSea 2000 metric stereocamera (Wheatcroft, 1994) mounted on a neutrally-buoyant, diver-manipulatable vehicle. Stereophotographs will be taken along numerous transects extending from open sand flats to seagrass meadows. Following standard film development, the images will be digitized at a high resolution (i.e., > 4000 pixels/inch) by a third-party aerial mapping firm and stored on CD-ROMs. Sea floor height information will be obtained from analytically rectified digital stereo-images using matching algorithms.

Independent, co-located measurements of sediment bioturbation intensity and mode will also be made during the field studies. The bioturbation measurements will involve the spreading of deliberate tracers

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(e.g., fluorescent pigments (Carey, 1989)) onto a patch of sea floor, followed by tube coring and vertical sectioning after periods of days to a month. Tracers will be enumerated fluorometrically. The bioturbation measurements will be made in various microenvironments (e.g., open, unvegetated sediment, near and in seagrass meadows) within the study sites.

WORK COMPLETED

The primary task completed during FY-97 was the design, fabrication and testing (in local waters) of the camera vehicle. To date, the vehicle has performed well. A pilot study planned for mid-November 1997 at the Monterey site will complete this phase of the research. The main study will occur in May 1998 at the Bahamas site. The second area of focus this past year involved development of the bottom roughness measurement protocol. Tasks completed include the identification and testing of a high-resolution scanning company (Image Scans), and the tailoring of the image processing software (L-H Systems, SOCET-SET) to the specific geometry of the PhotoSea stereocamera. To date, substantial progress has been made in forming a stereo-model with correct interior and exterior orientation, as well as absolute orientation. A manual digital terrain model (DTM) has been made, and a fully-automatic DTM is expected before the new year.

RESULTS

There have been no CoBOP field studies to date, hence no scientific results have been obtained.

IMPACT/APPLICATIONS

The development of a photographic system capable of quantifying sea floor microtopography is likely to have widespread application in marine geology. For example, studies of sediment transport and acoustical interactions with the sea bottom would both benefit from a knowledge of the short-term evolution of bottom roughness.

TRANSITIONS

No transitions are currently known, however, researchers at the Naval Research Laboratory (Stennis) are potential users of the stereomatching algorithm.

RELATED PROJECTS

The are two groups of CoBOP investigators that are likely to have significant interactions with this project. First, investigators in the optics group [e.g., C. Mobley (Sequoia Systems), R. Maffione (HOBI) and K. Voss (U Miami)] will be making a variety of measurements along the transects that will be correlated with the bottom roughness data. Second, members of the sediment [e.g., Fred Dobbs (ODU), Al Decho (U South Carolina) and L. Brand (U Miami) and seagrass [e.g., R. Zimmerman (Hopkins Marine Lab)] groups will be making various measurements of photosynthetic microalgae, bacteria, seagrass detritus and microbial exudates that will help interpret the bioturbation data. More detailed interactions will be developed at the CoBOP meeting scheduled for mid-November 1997.

REFERENCES

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